HPC Use in Military Analysis

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Agenda

- Objective
- Historical Approach
- Proposed Approach
- Issues and Challenges
- Acknowledgements

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Objective

- To present an approach to minimize the schedule time required to produce analytically valid results from a model execution.
- Minimize the impact on current processes and code bases.

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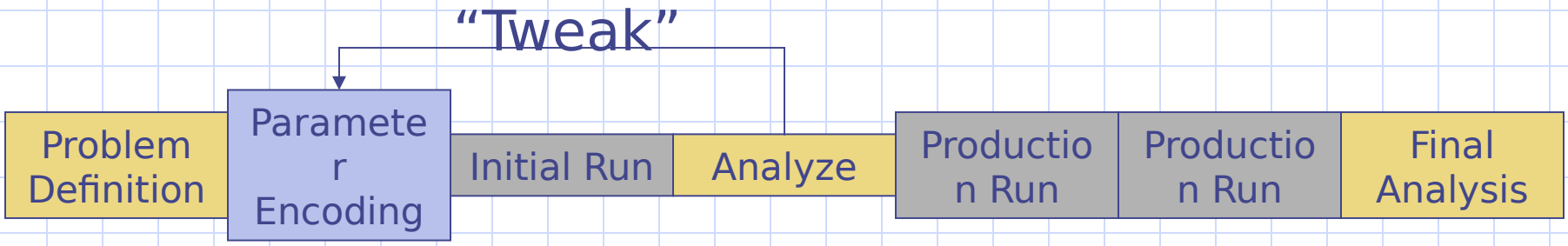
Historical Approach

- A largely sequential process that places the burden on the analyst's insight and ability
  - Limited number of runs available within a given time frame placed a premium on the individual runs
- Grew out of the limitations of the computers
  - Slow, high value resources



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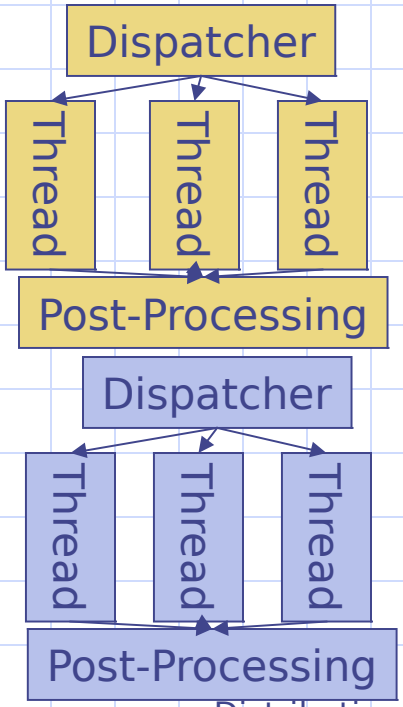
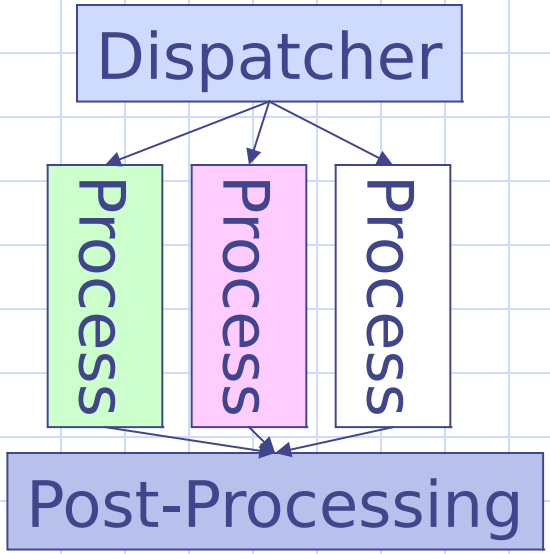
Ways To Parallelize

- Internal
  - Program is broken up into threads



- External
  - Multiple processes run concurrently



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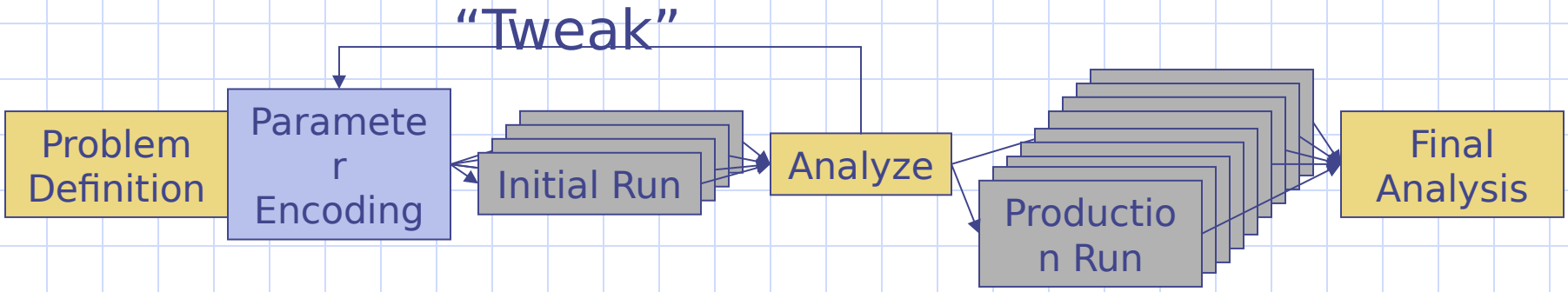
Proposed Approach

- Taking advantage of the parallel HPC resources to run multiple iterations concurrently.
- Creates more of a response surface in less time.
- Reduces the criticality of “correct” parameters for any given run.
- Allows for more “what if” runs.
  - Individual runs are now expendable



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Compute π on 8 times HPC

Use Case	Started	Finished	Elapsed
Sequential Code / Sequential Runs	21:10:19	21:19:00	00:08:41
Sequential Code / Parallel Runs	21:09:48	21:10:57	00:01:09
Parallel Code / Sequential Runs	12:58:04	12:59:51	00:01:46
Parallel Code / Parallel Runs	23:05:00	23:05:16	00:00:16

- SGI Origin 3900 w/ 2048 700 MHz MIPS R16000 processors
- π was computed 8 times using a bounded series approximation
- 1,000,000,000 iterations were used
- Parallel process was broken into 8 work units

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Relative Timings

	Iterations								
Threads	1.E+01	1.E+02	1.E+03	1.E+04	1.E+05	1.E+06	1.E+07	1.E+08	1.E+09
1	-52%	-50%	-55%	-58%	-53%	-7%	31%	36%	33%
2	-76%	-76%	-75%	-77%	-35%	34%	149%	166%	166%
4	-84%	-83%	-84%	-84%	-68%	18%	287%	398%	411%
8	-91%	-90%	-91%	-89%	-80%	-8%	310%	785%	899%

$$\textbf{Value} = (\textbf{Time}_{\textbf{PC}} - \textbf{Time}_{\textbf{HPC}}) / \textbf{Time}_{\textbf{HPC}}$$

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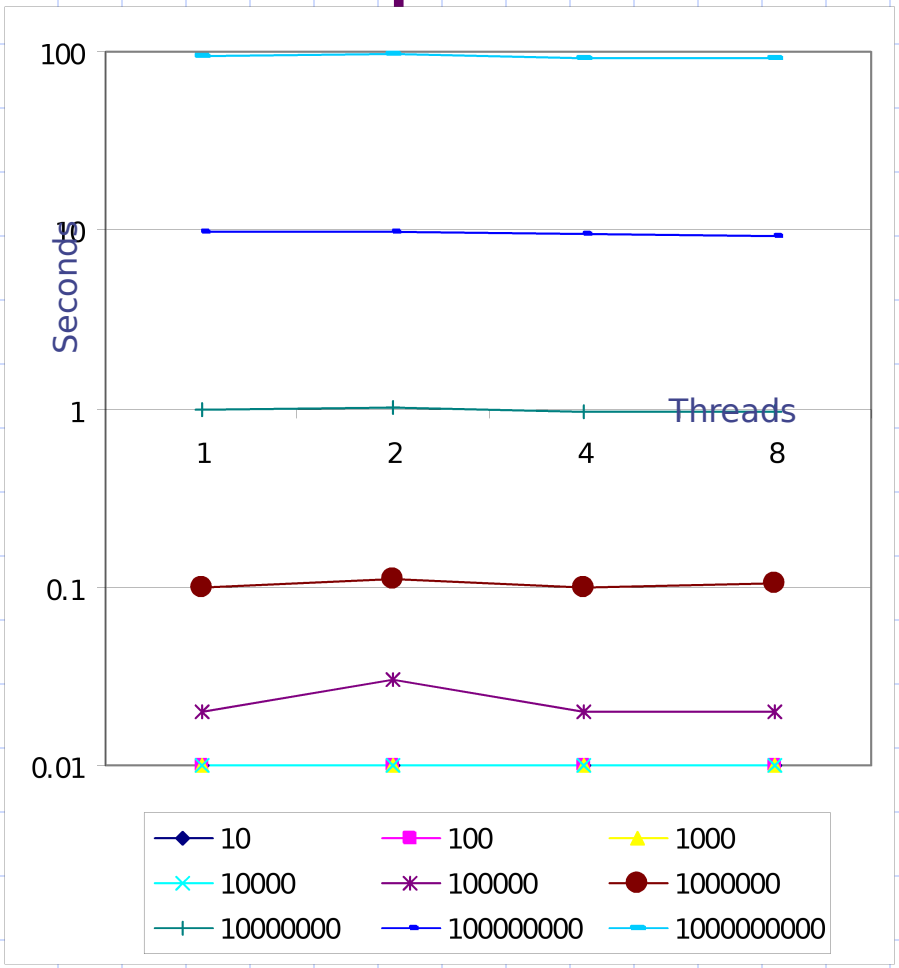
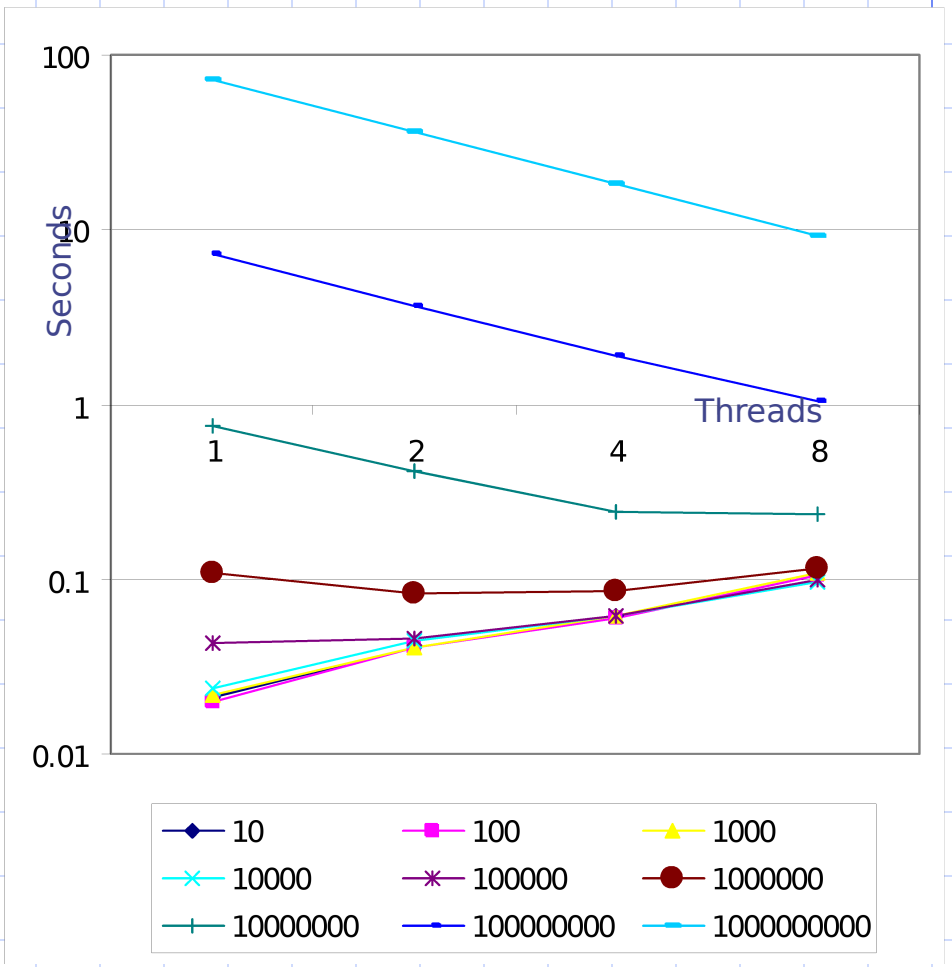
Compute π HPC vs PC





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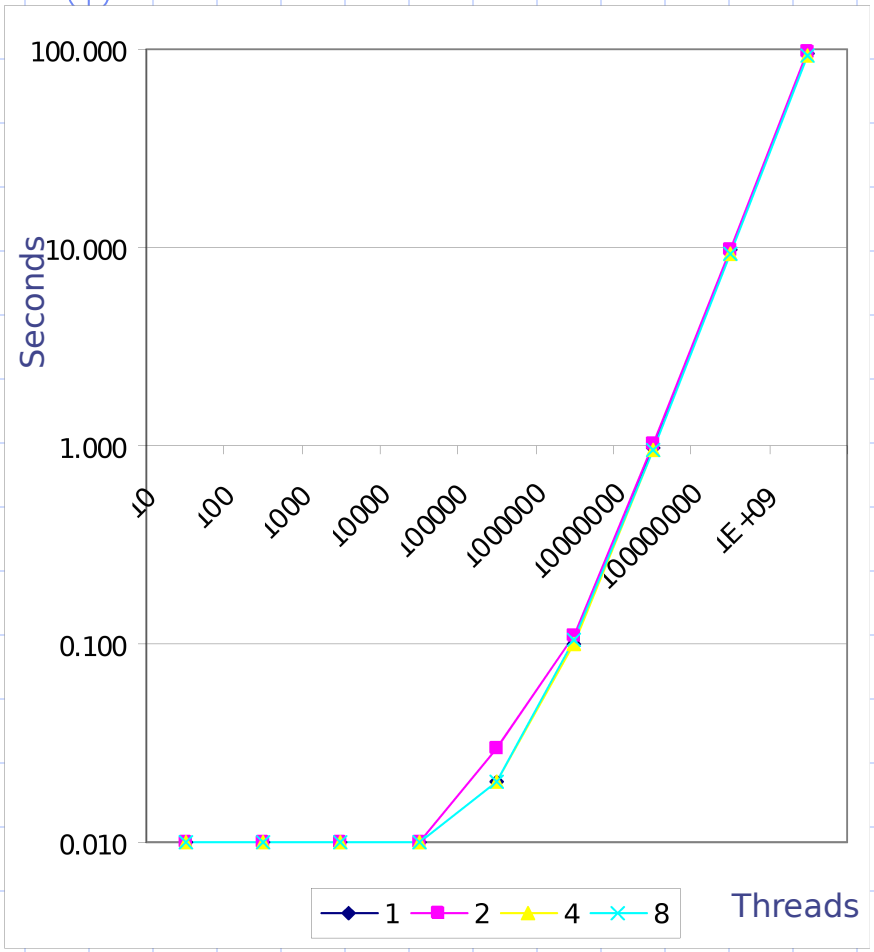
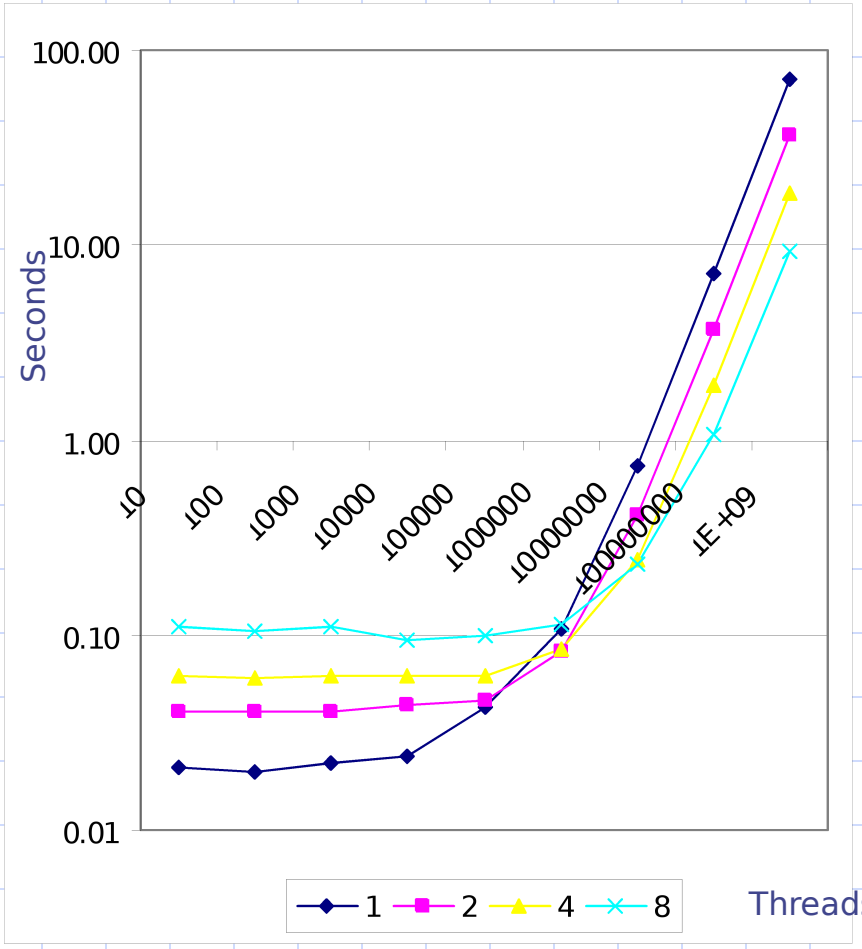
Compute π HPC vs PC





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Issues and Challenges

- Porting of codes to HPC resources
  - Concurrent independent runs make use of use existing closed form code base
  - HPC architectures are shifting to general purpose and Linux Clusters ➡ more consistent with workstation class machines
  - Not a problem with Java
- Data Volume
  - Data mining and warehousing techniques available on HPC machines simplify the backend analysis process
  - Still a major task to find inflection and pivot points

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Conclusions

- The computational resources available have increased dramatically, this does not change the need or the function of the analyst, rather it provides them a tool to take a look at a wider number of scenarios within a bounded time.
- The FMS PET program is funded to help new and existing users make use of HPC resources at no cost to the program.
  - We are looking for new users

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